PATENT SPECIFICATION (11) 1327353

1327353

NO DRAWINGS

(21) Application No. 20399/72 (22) Filed 2 May 1972

(31) Convention Application No. 139844 (32) Filed 3 May 1971 in

(33) United States of America (US)

(44) Complete Specification published 22 Aug. 1973

(51) International Classification A01N 9/02 9/20 9/30 9/32 9/22

(52) Index at acceptance

A5E 1A3B 1A3C 1A3F 1A3H 1A5A1 1A5A2 1C14 1C15A1 1C15A3 1C15D3 1C15D4 1C15F2 1C7C 1C7N 1C8A 1C8B 1C9A

(19)

(54) BIOCIDAL COMPOSITIONS

(71) I, HERBERT SCHWARTZ, a citizen of the United States of America, residing at 1963, North Maurice River Parkway, Vineland, New Jersey 08360, United States of America, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by

the weight ratio of the quaternary ammonium salt to the heterocyclic compound being in the range of 5:1 to 1:5. The compositions are of use against both gram negative and gram positive bacteria.

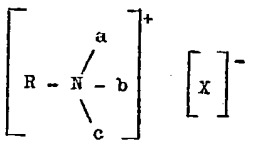
Quaternary ammonium salts are generally prepared by reaction of an alkyl halide and

ERRATUM

SPECIFICATION No. 1,327,353

Page 3, *between* lines 60 and 61 *insert* 5% N,N-diethyl-m-toluamide

THE PATENT OFFICE
3rd March, 1975



in which R is a C_{12}—C_{20} aliphatic radical, X is halogen, sulphate, C_1—C_7 alkyl sulphate, benzene sulphonate or C_1—C_{16} alkyl benzene sulphonate and a, b and c are the same or different and are chosen from C_1—C_7 alkyl, phenyl C_1—C_7 alkyl, phenoxy C_1—C_7 alkyl, thenyl and hydroxy alkynyl and a cage-type heterocyclic compound, containing four nitrogen atoms, formed by condensation of formaldehyde with ammonia, ethylene diamine, propylene diamine or o-phenylene diamine,

other of these rings. When o-phenylene diamine is used to make heterocyclic compound it also contains two benzene rings, each of which is fused to one of the heterocyclic rings.

The preferred heterocyclic compounds are hexamethylene tetramine, 1,3,6,8-tetraazatricyclo(4,4,1,$1^{3,8}$)dodecane and 4,5,9,10 - dibenzo - 1,3,6,8 - tetraazatricyclo(4,4,1,$1^{3,8}$)-dodecane. If desired, the compositions may contain two or more of the heterocyclic compounds.

The compositions may be formulated in a variety of ways e.g. as solutions, suspension, sprays, concentrates, emulsions or powders. The compositions may include any suitable carrier such as water, aqueous alkanols or organic solvents. Also, wetting agents, emulsifiers and perfumes may be present as may

[*Price 25p*]

SEE ERRATA SLIP ATTACHED

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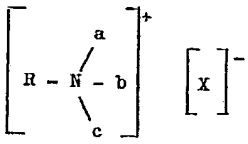
(54) BIOCIDAL COMPOSITIONS

(71) I, HERBERT SCHWARTZ, a citizen of the United States of America, residing at 1963, North Maurice River Parkway, Vineland, New Jersey 08360, United States of America, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

Organic mercury and tin compounds have been used to control bacteria and fungi but, because of their high toxicity and prolonged persistence, they are not generally used. Quaternary ammonium salts have been used to combat bacteria, fungi and algae but are generally too weak for most applications.

I have now devised biocidal compositions, comprising a quaternary ammonium salt and another essential component, which have a bactericidal activity considerably greater than the sum of the equivalent activity of the individual components when used separately i.e. the two essential components of the compositions interact synergistically. According to the invention a biocidal composition comprises a quaternary ammonium salt of general formula:



in which R is a C_{12}—C_{20} aliphatic radical, X is halogen, sulphate, C_1—C_7 alkyl sulphate, benzene sulphonate or C_1—C_{10} alkyl benzene sulphonate and a, b and c are the same or different and are chosen from C_1—C_7 alkyl, phenyl C_1—C_7 alkyl, phenoxy C_1—C_7 alkyl, thenyl and hydroxy alkynyl and a cage-type heterocyclic compound, containing four nitrogen atoms, formed by condensation of formaldehyde with ammonia, ethylene diamine, propylene diamine or o-phenylene diamine, the weight ratio of the quaternary ammonium salt to the heterocyclic compound being in the range of 5:1 to 1:5. The compositions are of use against both gram negative and gram positive bacteria.

Quaternary ammonium salts are generally prepared by reaction of an alkyl halide, sulphonate or sulphate with a tertiary amine. The salts of most interest are the halides e.g. chlorides and bromides, sulphates, methosulphates, ethosulphates and benzene and C_1—C_{10} alkyl benzene sulphonates. Suitable quaternary ammonium salts for the compositions according to the invention are described in Schwartz et al, Surface Active Agents and Detergents, Vol. II, 1958, p. 112 to 118. If desired, the compositions according to the invention may contain two or more quaternary ammonium salts.

The cage-type structure of the heterocyclic compounds that are usable in the compositions according to the invention arises because the compounds are non-planar and have a highly fused ring structure: the four nitrogen atoms are present in three nitrogen-containing heterocyclic rings, each of these rings having a side in common with each of the other of these rings. When o-phenylene diamine is used to make heterocyclic compound it also contains two benzene rings, each of which is fused to one of the heterocyclic rings.

The preferred heterocyclic compounds are hexamethylene tetramine, 1,3,6,8-tetraazatricyclo(4,4,1,$1^{3,8}$)dodecane and 4,5,9,10 - dibenzo - 1,3,6,8 - tetraazatricyclo(4,4,1,$1^{3,8}$)-dodecane. If desired, the compositions may contain two or more of the heterocyclic compounds.

The compositions may be formulated in a variety of ways e.g. as solutions, suspension, sprays, concentrates, emulsions or powders. The compositions may include any suitable carrier such as water, aqueous alkanols or organic solvents. Also, wetting agents, emulsifiers and perfumes may be present as may

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other components conventionally included in bactericidal compositions.

The compositions are of value for killing bacteria in a variety of situations e.g. in hospitals, in agriculture and in treating stored waste. The compositions are of use for preventing bacterial decomposition of organic matter leading to undesirable odours. Examples of such matter are urine from cats and other domestic animals, manure from fowl, cattle and horses and garbage.

The following Examples illustrate the invention.

Example 1

In this Example bactericidal activity was determined using the standard evaluation test for quaternary ammonium compounds described in Official Methods of Analysis of the Association of Official Agricultural Chemists, 10th edition (1965), p. 80—82 with a 15 minute exposure to *Pseudomonas aeruginosa* PRD-10. The materials, which were tested at increasing dilutions, were alkyl dimethyl benzyl ammonium chloride where alkyl was a mixture of C_{12} to C_{14} (A); hexamethylene tetramine (B) and 1:1 weight ratio mixture (C) of the chloride and hexamethylene tetramine. The results are given in Table I where + signifies no control and — signifies 100% control.

TABLE I

Concentration	A	B	C
1:3,200	—	+	—
1:6,400	—	+	—
1:12,800	+	+	—
1:25,600	+	+	—
1:51,200	+	+	+

Table I shows that in this test hexamethylenetetramine had no bactericidal activity but increased the bactericidal activity of alkyldimethylbenzylammonium chloride four times. This is a clear demonstration of synergistic activity.

Example 2

The test of Example 1 was repeated but using 1,3,6,8 - tetraazatricyclo[4,4,1,$1^{3,8}$]-dodecane (D) as the heterocyclic compound and a 2:1 weight mixture (E) of this heterocyclic compound and the quaternary ammonia chloride. In this Example *Staphylococcus aureus* (SA) and *Salmonella typhosa* (ST) where used as test organisms. The results are given in Table II.

TABLE II

Concentrations	A^{SA}	D	E	A^{ST}	D	E
1:1,000	+	+	—	—	+	—
1:5,000	+	+	—	—	+	—
1:10,000	+	+	—	+	+	—
1:15,000	+	+	+	+	+	+
1:20,000	+	+	+	+	+	+

The results of Table II show that the mixtures tested are synergistic and effective against both gram negative and gram positive bacteria. The effective control of *Staphylococcus aureus* indicates that the mixtures could be used in hospital cleaning solutions as a disinfectant.

The tests were repeated using 4,5,9,10 - dibenzo - 1,3,6,8 - tetraazatricyclo[4,4,1,$1^{3,8}$]-dodecane as the heterocyclic compound and test results similar to those of Table II were obtained.

Example 3

A mixture of 25 parts by weight of hexamethylenetetramine with 52 parts by weight of water was added, with stirring, to a mixture of 0.5 parts by weight of perfume, 10.0 parts by weight of a polyethylene oxide-alkylphenol adduct as an emulsifier and 12.5 parts by weight of alkyl dimethylbenzyl ammonium chloride (alkyl of 12 to 16 carbon atoms) to form a clear solution. 1 to 2 ml. of the solution was admixed with 1 pound of kitty litter which was used by two adult cats in a closed room for one week. During this time, there was none of the odour typical of microbial decomposition of urine.

Example 4

The solution prepared in Example 3 was sprayed about the interior of chicken coops and particularly on the manure covered floors. The strong objectionable odour of chicken manure was eliminated almost immediately after the spraying.

Example 5

A solution of 10 parts by weight of hexamethylenetetramine in 20 parts by weight of water was mixed with vigorous stirring with a solution of 25 parts by weight of methyl-

ated napthalene, 20 parts by weight of polyoxyethylenealkylphenol adduct as an emulsifier, 12 parts by weight of Culversan LC 80 (alkyldimethylbenzylammonium chloride-alkyl of 12 to 18 carbon atoms), 5 parts by weight of lindane, 5 parts by weight of perfume, 3 parts by weight of dichlorobenzene and 1 part by weight of 2 - ethyl - 1,3 - hexanediol to obtain a concentrated, straw-coloured solution.

One pint of this solution was poured into a tank containing 55 gallons of water, and the resulting solution was sprayed onto garbage and the inside of garbage containers. This treatment eliminated the odour of decaying garbage. The containers and enclosed container sites were located at canning factories, supermarkets, and hamburger stands, and the time of the trials was mid-summer. During the trials people consumed food and drink parked next to garbage bins, which, if untreated, would have been producing unappetising odours.

Example 6

The following solutions were prepared and tested as garbage odour inhibitors as in Example 5 and were found to be effective to control odour produced by bacteria decomposing the organic matter.

Solution 1
- 10% by weight of hexamethylenetetraamine
- 12% Culversan LC 80 (Culver Corp)
- 18% Emulsifier of Example 3
- 22% Water
- 4.5% Perfume
- 2.5% 2 - ethyl - 1,3 - hexanediol as insect repellent
- 2.5% lindane
- 4.0% p-dichlorobenzene
- 24.5% methylated naphthalene

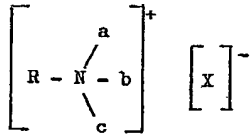
Solution 2
- 4% by weight of p-dichlorobenzene
- 18% Neutronyx 600 (a phenyl polyethylene glycol ether sold by Millmaster Onyx Corporation)
- 2.5% lindane
- 2.5% insect repellent (N,N - diethyl - m - toluamide)
- 10% Culversan LC 80
- 12% hexamethylenetetraamine
- 5% perfume
- 22% water
- 24% mineral oil

Solution 3
- 20% by weight of hexamethylenetetraamine
- 15% Culversan LC 80
- 10% Emulsifier of Example 3
- 5% perfume
- 45% water

Solution 4
- 24% by weight of petroleum base
- 22% water
- 20% Emulsifier of Example 3
- 12% Culversan LC 80
- 10% hexamethylenetetraamine
- 5% p-dichlorobenzene
- 5% perfume
- 2% 2 - ethyl - 1,3 - hexanediol.

WHAT I CLAIM IS:—

1. A biocidal composition comprising a quaternary ammonium salt of general formula:



in which R is a C_{12}—C_{20} aliphatic radical, X is halogen, sulphate, C_1—C_7 alkyl sulphate, benzene sulphonate or C_1—C_{10} alkyl benzene sulphonate and a, b and c are the same or different and are chosen from C_1—C_7 alkyl, phenyl C_1—C_7 alkyl, phenoxy C_1—C_7 alkyl, thenyl and hydroxy alkynyl and a cage-type heterocyclic compound, containing four nitrogen atoms, formed by condensation of formaldehyde with ammonia, ethylene diamine, propylene diamine or o-phenylene diamine, the weight ratio of the quaternary ammonium salt to the heterocyclic compound being in the range of 5:1 to 1:5.

2. A composition according to claim 1 in which the heterocyclic compound is hexamethylenetetramine.

3. A composition according to claim 1 in which the heterocyclic compound is 1,3,6,8 - tetraazatricyclo[4,4,1,$1^{3,8}$]dodecane.

4. A composition according to claim 1 in which the heterocyclic compound is 4,5,9,10 - dibenzo - 1,3,6,8 - tetraazatricyclo[4,4,1,$1^{3,8}$]-dodecane.

5. A composition according to any preceding claim in which the weight ratio of the quaternary ammonium salt to the heterocyclic compound is in the range of 2:1 to 1:2.

6. A composition according to claim 1 sub-

stantially as hereinbefore described with reference to any of the Examples.

7. A method of killing bacteria comprising contacting the bacteria with a composition according to any preceding claim.

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